answer this purpose. Whatever the object may have been, there can be no doubt as to the tedious and complicated nature of the means employed.

Before the twenty-first dynasty, the process of embalming resulted in a mummy which was simply a skeleton wrapped in a wrinkled covering of shrivelled skin. In this dynasty, or at the close of the twentieth, the process of packing or "stuffing" was introduced to avoid the shrivelling of the flesh and distortion of the body which marred the work of the older embalmers. The mortal flesh was replaced by subcutaneous packings of durable material such as mud, sand, lime, and sawdust, with occasionally an addition of aromatic vegetable substances such as onion. The eyes of the great Rameses IV. were replaced by onions. After the twenty-first dynasty, the art of embalming declined. Subcutaneous packing was discontinued, the surface form of the body being restored by swathing the limbs and body by an artistic application of bandages; later still all distortion was hidden by a free application of pitch and bandage to the shrunken trunk and limbs.

In the course of his investigations, Elliot Smith was able to verify certain statements made by Herodotus and by Diodorus Siculus concerning the methods of embalming employed by the ancient Egyptians. Herodotus describes the extraction of the brain through a small opening made on the roof of the nasal cavity—a procedure which Greenhill characterised as "amusing and impracticable." It was found that all the mummies belonging to the seventeenth and later dynasties showed clear evidence of the truth of the ancient description; early in last century, T. J. Pettigrew also verified it. In the writings of Pettigrew and in Brugsch's translation of the Rhind Papyri, the author of the memoir found much that assisted him in re-constructing the details of the process used by the embalmers. Broadly speaking, there were three stages: (1) the viscera were removed from the body through a wound in the left flank, the heart being invariably left in the trunk; (2) the body was then placed in brine for a period of thirty or forty days; the viscera were preserved in a similar medium within the four "Canopic Jars," each of which was dedicated to one of the four children of Horus; (3) after removal from the salt bath the body, now much shrunken, was packed; from the arrangement of the packing, Elliot Smith found it possible to tell the exact manner and order in which this had been accomplished; it is unnecessary here to mention the details, but one may safely state that these ancient embalmers must have had a very considerable knowledge of the anatomy of the human body.

The process of packing was finished by returning the contents of the four canopic jars to the body cavity; they were arranged in four packages, and were usually replaced within the cavity in a certain definite order. In each package it was the custom to enclose the image of one of the four children of Horus —"funerary genii," as they are named in this memoir.

The following statement of Pettigrew is quoted in this connection:—

"To Amset were dedicated the stomach and large intestines; to Hapi the small intestines; to Smautf (Tuamâutef) the lungs and heart; and to Kebhsnuf the liver and gall bladder."

On this Prof. Elliot Smith makes the following commentary:—

"The examination of a still larger series of mummies of this period (twenty-first dynasty) has convinced me that, in spite of frequent irregularities, a definite association was intended—but the guardianship of the various Genii is by no means identical with that suggested by Pettigrew. Thus the human *Amset* is usually found wrapped up in the *liver* instead of the stomach and large intestines, the ape-headed *Hapi* is usually associated with the *left lung* rather than the small intestines, the Jackal *Tuamâutef* with the stomach . . . and the hawk-headed *Kebhsnuf* . . . in the parcel of intestines."

There are many other points in this memoir which are deserving of notice, but enough has been said to show its value as a real contribution to our knowledge of the ancient Egyptians.

ASTRONOMICAL REFRACTION.

WHEN a ray of light passes through a medium of uniform density, the path described is a straight line. Should this ray meet obliquely another medium of different density it is bent or refracted. If the second medium is more dense than the first, then the ray as it enters the second medium is refracted towards the normal, or that line at right angles to the tangential plane at the point where the ray enters the second medium.

In the case of astronomical refraction, the light, say, from a star, passes through space and then penetrates the earth's atmosphere, a medium which is in all parts denser than the space between the star and the upper limit of the earth's atmosphere. By the time the ray reaches the observer it will therefore be considerably bent towards the normal. If our atmosphere were homogeneous, that is, if it were of equal density throughout, the star's light would pass in a straight line from the point where it first penetrated it to the observer's eye. We know, however, that our atmosphere is far from being of uniform density, and one has not to climb a mountain or ascend in a balloon very high before this fact is made plain.

Up to a few years ago little was known with certainty about the physical conditions of the upper atmosphere, except the broad idea that the air became less dense the greater the distance from the earth's surface, and that at the same time the temperature readings were lower and lower.

This limited knowledge of our atmospheric conditions rendered it necessary to make some assumptions as to the law of decrease of density. This was imperative, because it was of vital importance to astronomers and mariners to know how much the ray of light from a celestial object had been bent after it had penetrated our aërial envelope. In fact, what was required was the difference between the apparent and actual direction of the heavenly body in the sky.

The assumption finally made was that the atmosphere consisted of a series of concentric spherical layers the common centre of which was the centre of the earth. Each layer was considered of uniform density, and these densities or temperatures and refractive powers all decreased as the surface of the earth was left behind, the amount of decrease varying in a prescribed way and agreeing in the main with the actual, but few, observations made in balloons and on mountain tops. On this assumption, then, the ray which entered our atmosphere was always meeting with denser and warmer layers of air, and gradually becoming more and more bent as each consecutive layer was passed through.

During the course of the last few years very rapid strides have been made in investigating the upper air by means of manned and unmanned balloons and kites carrying meteorological instruments, and eleva-

tions have been reached which formerly were impossible to attain. The data collected at various heights above the earth's surface have now, therefore, become considerable, and our knowledge of the distribution of atmospheric temperature has in this way been greatly advanced. Thus it is known that the temperature does not gradually decrease as greater elevations are reached at the rate that was previously assumed. In fact, numerous records from automatic instruments have shown that at some heights quite considerable rises in temperature, extending through large depths of atmosphere, have been noted, these inversions being far more common than was at first contemplated.

With this condition of things so prominently brought out, it is at once obvious that some attention should be paid to a possible revision of the assumption on which the theory of astronomical refraction is based, because the path of a ray of light traversing such variously heated layers may not be the same as that computed on the old hypothesis.

Fortunately this question is now receiving some attention, and this is shown by a recent preliminary paper by Prof. H. G. van de Sande Bakhuyzen entitled "On the Astronomical Refractions Corresponding to a Distribution of the Temperature derived from Balloon Ascents," which appeared in the *Koninklijke Akademie van Wetenschappen te Amsterdam* (January 26).

In this investigation Prof. Bakhuyzen has employed observations made on 182 different days, of which fifty-eight were made with unclouded and 124 with clouded sky. The ascents were made from Halde (in Denmark), Berlin, Paris, Strassburg, and Vienna, so that the values which he gives for temperatures at heights from 0 kilometre to 16 kilometres apply to the mean of the area enclosed by those stations. The values for the means above 13 kilometres are, as he states, not very certain, but the observations indicate that the temperature at these heights decreases slowly.

As this table is of considerable interest, a portion of it may be given here:—

Temperatures (centigrade) at heights from 0–16 kilometres for clear weather.

Height	Annual mean	Diff.
0	+ 6·4	
		−1·1
1	+ 5·3	
		−4·3
2	+ 1·0	
		−4·8
3	− 3·8	
		−5·5
4	− 9·3	
		−6·1
5	−15·4	
		−6·4
6	−21·8	
		−6·7
7	−28·5	
		−7·3
8	−35·8	
		−7·4
9	−43·2	
		−6·4
10	−49·6	
		−5·1
11	−54·7	
		−2·3
12	−57·0	
		−1·0
13	−58·0	
		−0·6
14	−58·6	
		−0·4
15	−59·0	
		−0·2
16	−59·2	

The result of this preliminary investigation shows that when the refractions for zenith distances greater than 85° have been determined, the values for these alone are given in the paper, the values deviate perceptibly from those deduced from Ivory's theory.

Even if great weight be not put on this result, the inquiry is one which should undoubtedly be taken up again when more data are forthcoming. The astronomer of to-day is perhaps inclined to look upon the results of the computation of refraction by methods at present in use as strictly correct, but evidently due regard must now be paid to new data rendered available by atmospheric soundings. The subject of Prof. Bakhuyzen's inquiry is therefore of considerable importance, and future research in this direction will be followed with interest.

NOTES.

IN the issue of the *Revue Scientifique* for March 30 are re-printed portions of the funeral oration delivered by M. Briand, the Minister of Public Instruction, at the national funeral of M. and Mme. Berthelot at the Panthéon on March 25. M. Briand, speaking of Berthelot, said:—"The illustrious man of science, the great Frenchman for whom we mourn, was one of those colossal men who are an honour to every country and every age. He thought it the duty of every citizen to interest himself in the affairs of his city, and that is why his life was so multiplex, why his activities were exercised in such various directions. Probably he would have preferred to give all his time to his laboratory and his favourite studies; but when the public interest called him, when it looked to him to place his science at the service of the national defences of education, of general politics, Marcellin Berthelot did his duty simply, and we have thus to celebrate to-day at the same time the man of science, the philosopher, the educator, the politician and *l'honnête homme*." Toward the close of his oration M. Briand remarked that he had been called by his position "to the painful and formidable honour of rendering homage, in the name of the Government, to the man of genius for whom universal science is in mourning"; he then proceeded to give a touching eulogy of Berthelot as a private individual. The discourse serves admirably to show the high esteem in which the French people and rulers hold their great men of science.

DR. NANSEN will give a paper on "Polar Problems" at the Royal Geographical Society on Monday, April 29; on May 13 a paper on "An Expedition from the Niger to the Nile" will be read by Lieut. Boyd Alexander.

AT the recent annual meeting of the Royal Irish Academy Prof. F. A. Tarleton was elected president for the session 1907–8, and the following were elected honorary members in the section of science:—Profs. Ramon Y. Cajal, Madrid; W. Ostwald, Leipzig; E. C. Pickering, Cambridge (Mass.), U.S.A.; and H. Poincaré, Paris.

A REUTER message from Constantinople reports that considerable damage has been done to property at Bitlis by violent earthquake shocks on March 29.

ON Tuesday, April 9, Prof. G. H. Bryan, F.R.S., will begin a course of two lectures at the Royal Institution on "Wings and Aëroplanes"; on Thursday, April 11, Prof. H. A. Miers, F.R.S., will commence a course of two lectures on "The Birth and Affinities of Crystals," and on Saturday, April 13, Prof. Silvanus P. Thompson, F.R.S., will begin a course of three lectures on "Studies in Magnetism" (the Tyndall lectures). The Friday evening discourse on April 12 will be delivered by Prof. A. H. Church, F.R.S., the subject being "Conservation of Historic Buildings and Frescoes," and on April 19 by Prof. C. S. Sherrington, F.R.S., on "Nerve as a Master of Muscle."

MR. ANDREW CARNEGIE has invited a large party of guests from England to attend the dedication of the new building of the Carnegie Institute at Pittsburg, Pennsyl-